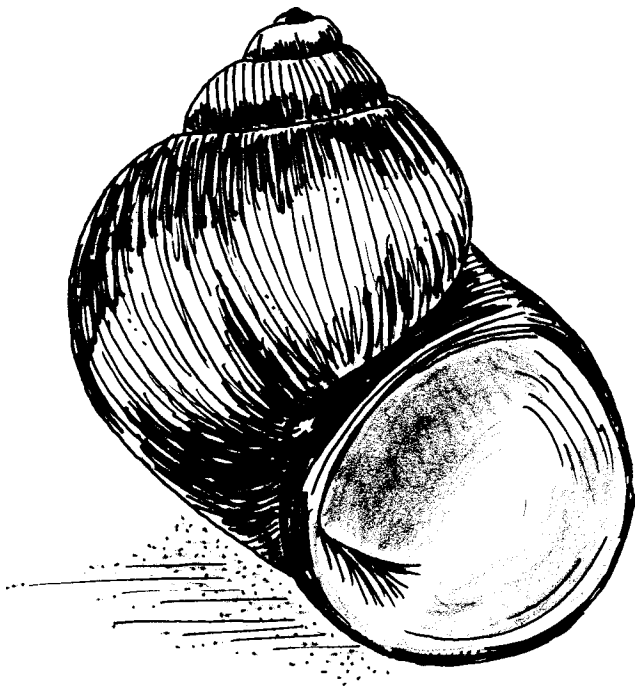
U.S. Fish & Wildlife Service

Bruneau Hot Springsnail

RECOVERY PLAN



Pyrgulopsis bruneauensis

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RECOVERY PLAN

FOR THE

BRUNEAU HOT SPRINGSNAIL

(*Pyrgulopsis bruneauensis*)

Region 1
U.S. Fish and Wildlife Service
Portland, Oregon

Approved: _____
Regional Director, Region 1, U.S. Fish and Wildlife Service

Date: 9/30/02

Disclaimer

Recovery plans delineate reasonable actions which are believed to be required to recover and/or protect the species. Plans are prepared by the U.S. Fish and Wildlife Service, sometimes with the assistance of recovery teams, contractors, State agencies, Tribal agencies, and others. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation, other than the U.S. Fish and Wildlife Service. They represent the official position of the U.S. Fish and Wildlife Service only after they have been signed by the Regional Director or Director as approved. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

Literature Citation should read as follows:

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Authors

The Bruneau Hot Springsnail (*Pyrgulopsis bruneauensis*) Recovery Plan was prepared by Jeri Wood and Steven Lysne, U.S. Fish and Wildlife Service, Snake River Basin Office, Boise, Idaho.

Executive Summary

Current Species Status: The Bruneau hot springsnail (*Pyrgulopsis bruneauensis*) was listed as endangered on June 17, 1998 (U.S. Fish and Wildlife Service 1998). The species currently survives in approximately 89 of 155 small, flowing geothermal springs and seeps along an approximately 8-kilometer (5-mile) reach of the Bruneau River and its tributary Hot Creek in southwestern Idaho. The species is found in a narrow elevation range of 803.7 to 815.7 meters (2,636.9 to 2,676.1 feet).

Habitat Requirements and Limiting Factors: The Bruneau hot springsnail has been found in flowing geothermal springs and seeps with temperatures ranging from 15.7 to 36.9 degrees Celsius (60.3 to 98.4 degrees Fahrenheit), with the highest densities of springsnails observed at temperatures ranging from 22.8 to 36.6 degrees Celsius (73 to 98 degrees Fahrenheit). Bruneau hot springsnails are found in these habitats on the exposed surfaces of various substrates, including rocks, gravel, sand, mud, and algal film. The principal threat to this species is the reduction and/or elimination of their geothermal spring habitat as a result of agricultural-related groundwater withdrawal and pumping.

Recovery Objective: To recover the species to the point where delisting is warranted.

Recovery Priority Number: The recovery priority for the Bruneau hot springsnail is 2C on a scale of 1 to 18, indicating that it is: 1) taxonomically, a species; 2) facing a high degree of threat; 3) rated high in terms of recovery potential; and 4) may be in conflict with construction or other development projects or other forms of economic activity.

Recovery Criteria: The Bruneau hot springsnail will be considered for downlisting to a threatened status when groundwater management activities have been implemented and monitoring indicates an increasing trend in water levels in the geothermal aquifer and occupied geothermal springs for a period of 10 years. Delisting of the species will be considered when: 1) water levels in the geothermal aquifer have increased and stabilized at 815 meters (2,674 feet) in

elevation (as measured in October in three of the Hot Creek area water monitoring wells [United States Geological Survey well numbers 03BDC1, 03BDC2, 04DCD1]); 2) the total number of geothermal springs discharging within the recovery area[1] is 200 or more and are distributed within the current range of the Bruneau hot springsnail; 3) more than two-thirds of available geothermal springs within the recovery area (approximately 131 springs) are occupied by stable, medium to high density populations of the Bruneau hot springsnail; and 4) groundwater levels are permanently protected against further reductions through implementation of groundwater management activities.

Actions Needed:

1. Implement conservation measures to increase water levels in the regional geothermal aquifer. Geothermal spring discharges should be permanently protected within the recovery area, as measured in October, annually, at three Hot Creek monitoring wells (United States Geological Survey well numbers 03BDC1, 03BDC2, 04DCD1), at an elevation of 815 meters (2,674 feet).

2. Implement a groundwater monitoring program to assess changes in the geothermal aquifer.

3. Implement a monitoring program to assess the survival and recovery of the Bruneau hot springsnail and its habitat.

4. Develop and implement a habitat restoration program within the recovery area.

5. Develop and implement a control program for non-native fish that prey upon the Bruneau hot springsnail within the recovery area.

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[1] The recovery area (see Figure 3) begins at the point where the Bruneau River crosses the southern boundary of Township (T) 08 South (S), Range (R) 06 East (E), Section (S) 12 and continues downstream (including Hot Creek from the confluence of the Bruneau River to the Indian Bathtub) to the point where the Bruneau River crosses the northern boundary of T07S, R06E, S35 of Owyhee County, Idaho (all within East Boise Meridian).

6. Manage Federal lands to promote recovery of the Bruneau hot springsnail.

7. Develop and implement a groundwater recharge model that stabilizes the geothermal aquifer at the recovery elevation. Conduct research to determine the feasibility of restoring Upper Hot Creek as suitable Bruneau hot springsnail habitat, and translocation and establishment of additional Bruneau hot springsnail colonies within the recovery area.

8. Seek funding for implementation of recovery tasks.

9. Monitor and evaluate the success of recovery actions with regard to fulfilling the recovery objectives, criteria, actions needed, and removal of threats as outlined in the plan.

Recovery Actions to Date: Since 1991, we, the U.S. Fish and Wildlife Service, have provided funding for annual Bruneau hot springsnail surveys and bi-annual range-wide surveys in geothermal springs within the range of the species in the Bruneau River. In addition, with our funding assistance, the U.S. Geological Survey completed monitoring of well water levels and spring discharges from the geothermal aquifer. The Bureau of Land Management has installed fencing along the east and west sides of the Bruneau River and Hot Creek to provide protection from livestock trampling of the geothermal springs (Bruneau hot springsnail habitat). The Bureau of Land Management has also co-funded, with us, the population monitoring of four geothermal springs occupied by Bruneau hot springsnails since 1993. The Bruneau hot springsnail conservation committee is currently reviewing proposals for funding that will conserve the use of geothermal water for irrigation.

Estimated Cost of Recovery: The estimated cost of downlisting is approximately $7.5 million over 10 years; for delisting, the estimated cost is approximately $15 million over a 15-year period beginning upon implementation of this plan.

Date of Recovery: Downlisting could be initiated immediately after recovery criteria have been met. However, at least 10 years following implementation of recovery tasks may be necessary before recovery criteria are fully or partially met.

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I. Introduction

A. Brief Overview

On June 17, 1998, we, the U.S. Fish and Wildlife Service, reaffirmed the 1993 listing of the Bruneau hot springsnail (*Pyrgulopsis bruneauensis*) as endangered (U.S. Fish and Wildlife Service 1998) in a court-ordered reconsideration of the 1993 final listing decision. The species occupies 89 geothermal springs in the Bruneau River/Hot Creek area, based on the last rangewide survey in 1999. Four of the occupied sites have been actively monitored since 1991, and monitoring of an additional 17 sites was initiated in 2000 (see the Conservation Measures section of this recovery plan) for a total of 21 monitoring sites (Rugenski and Minshall 2002). Restoration and protection of the geothermal aquifer from which preferred geothermal spring habitats arise along the Bruneau River is important to the continued survival of the Bruneau hot springsnail.

B. Species Account

The Bruneau hot springsnail was first collected in springflows at the Indian Bathtub in upper Hot Creek along the Bruneau River in 1952 (Hershler 1990). In 1953, J. P. E. Morrison determined that it represented a previously unknown genus and species of springsnail of the family *Hydrobiidae* (Hershler 1990). Taylor (1982) pursued subsequent field and laboratory studies of this species from 1959 through 1982. Based on these studies, Taylor prepared a brief physiological and biological description of the species and suggested the common name of the Bruneau hot spring snail. Subsequently, Hershler (1990) formally described the species from type specimens collected from the Indian Bathtub in Hot Creek as *Pyrgulopsis bruneauensis*, with a new common name of Bruneau hot springsnail (Figure 1).

Adult Bruneau hot springsnails have a small, globose (short, fat, rounded) to low-conic (short and cone-shaped, without many whorls) shell reaching a length of 5.5 millimeters (0.22 inches) with 3.75 to 4.25 whorls (Figure 1).

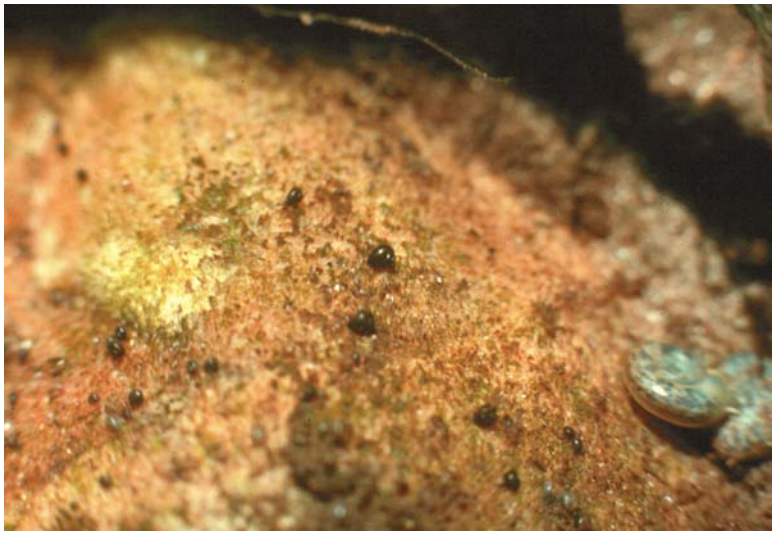

Figure 1. Photo of Bruneau hot springsnail (Pat Olmstead, BLM, used with permission)

Figure 2. Photo of typical Bruneau hot springsnail habitat (USFWS)

Fresh shells are thin, transparent, white-clear, appearing black due to pigmentation (Hershler 1990). In addition to its small size (less than 2.8 millimeters [0.11 inch] shell height), distinguishing features include a verge (penis) with a small lobe bearing a single distal glandular ridge and elongate, muscular filament.

Sexual maturity can occur at 2 months, with a sex ratio approximating 1 to 1. Reproduction occurs throughout the year except when inhibited by high or low temperatures (Mladenka 1992). At sites affected by high ambient temperatures during summer and early fall months, recruitment is seasonal, corresponding with cooler periods. Likewise, sites with cooler ambient temperatures would likely exhibit recruitment during the summer months (Mladenka 1992). Springsnails use "hard" surfaces such as rock substrates to deposit their eggs (Mladenka 1992).

The Bruneau hot springsnail appears to be an opportunistic grazer, feeding primarily on algae and diatoms. Springsnail densities are lowest in areas of bright green algal mats, while higher springsnail densities occur where periphyton communities[2] are dominated by diatoms (Mladenka 1992). Springsnail abundance generally fluctuates seasonally; abundance is influenced primarily by water temperature, spring discharge, and food availability (Mladenka 1992, Varricchione and Minshall 1997). Mladenka (1992) also noted that fluctuations in springsnail abundance corresponded with changes in food quality based on chlorophyll content.

The species has been found in flowing geothermal springs and seeps with temperatures ranging from 15.7 to 36.9 degrees Celsius (60.3 to 98.4 degrees Fahrenheit), with highest densities (greater than 1,000 per square meter, ≈1,000 per square yard) of snails noted at temperatures ranging from 22.8 to 36.6 degrees Celsius (73 to 98 degrees Fahrenheit) (Mladenka 1992). Temperature extremes (below 15.7 degrees Celsius, 60.3 degrees Fahrenheit, and above 35 degrees Celsius, 95 degrees Fahrenheit) affect both abundance and recruitment of Bruneau hot springsnails (Mladenka 1992). Geothermal spring elevations in the Bruneau River range from 803.7 to 815.7 meters (2,636.9 to 2,676.1 feet) (D. Brunner, in

[2] A dynamic “community” of single celled algae, protozoa, and bacteria, encased in a polysaccharide (simple sugar) matrix which exists on virtually all surfaces of continuously wetted aquatic substrates.

litt. 1994). The elevation at the Indian Bathtub spring, in Hot Creek, is 814.7 meters (2,672.9 feet).

Bruneau hot springsnails are found on the exposed surfaces of various substrates, including rocks, gravel, sand, mud, and algal film (Figure 2), within geothermal spring habitats (Mladenka 1992). However, during the winter period of cold ambient temperatures and icing, the springsnails are most often located on the underside of outflow substrates; habitats least exposed to cold temperatures (Mladenka 1992). In madicolous habitats (thin sheets of water flowing over rock faces), the species has been found in water depths less than 1 centimeter (0.39 inch). Current velocity is not considered a significant factor limiting Bruneau hot springsnail distribution, since they have been observed to inhabit nearly 100 percent of the available current regimes (Mladenka 1992).

As recently as 1999, the Bruneau hot springsnail occupied 89 of the 155 small, flowing geothermal springs and seeps along an 8-kilometer (5-mile) reach of the Bruneau River in southwestern Idaho (Mladenka and Minshall 1996) (Figure 3). Range-wide surveys indicate a decline in the total number of geothermal springs since 1991 by 27 percent, from 211 to 155. The number of geothermal springs occupied by Bruneau hot springsnails has also declined since 1991; from 131 to 116 occupied springs in 1996, and 66 occupied springs in 1998 (Mladenka and Minshall 1996, Myler and Minshall 1998 respectively). Most of the occupied springs are located along the Bruneau River at the confluence of, and upstream of, Hot Creek, on lands administered by the Bureau of Land Management (Figure 3). Some additional geothermal springs are located downstream of the Indian Bathtub and Hot Creek and are located on private land. Most do not provide suitable geothermal conditions for the Bruneau hot springsnail (Mladenka 1992).

The aquatic community associated with the Bruneau hot springsnail includes three additional rare plant and invertebrate species including an endemic snail, *Ambrysus mormon minor*, that has been found in Hot Creek and a few adjacent geothermal springs (Bowler and Olmstead 1991). The skiff beetle (*Hydroscapha natans)* historically occurred in Hot Creek, however, surveys conducted by Bowler and Olmstead (1991) did not find this species again. Hot Creek and the Bruneau River represent the northernmost location for this species. *Epipactis*

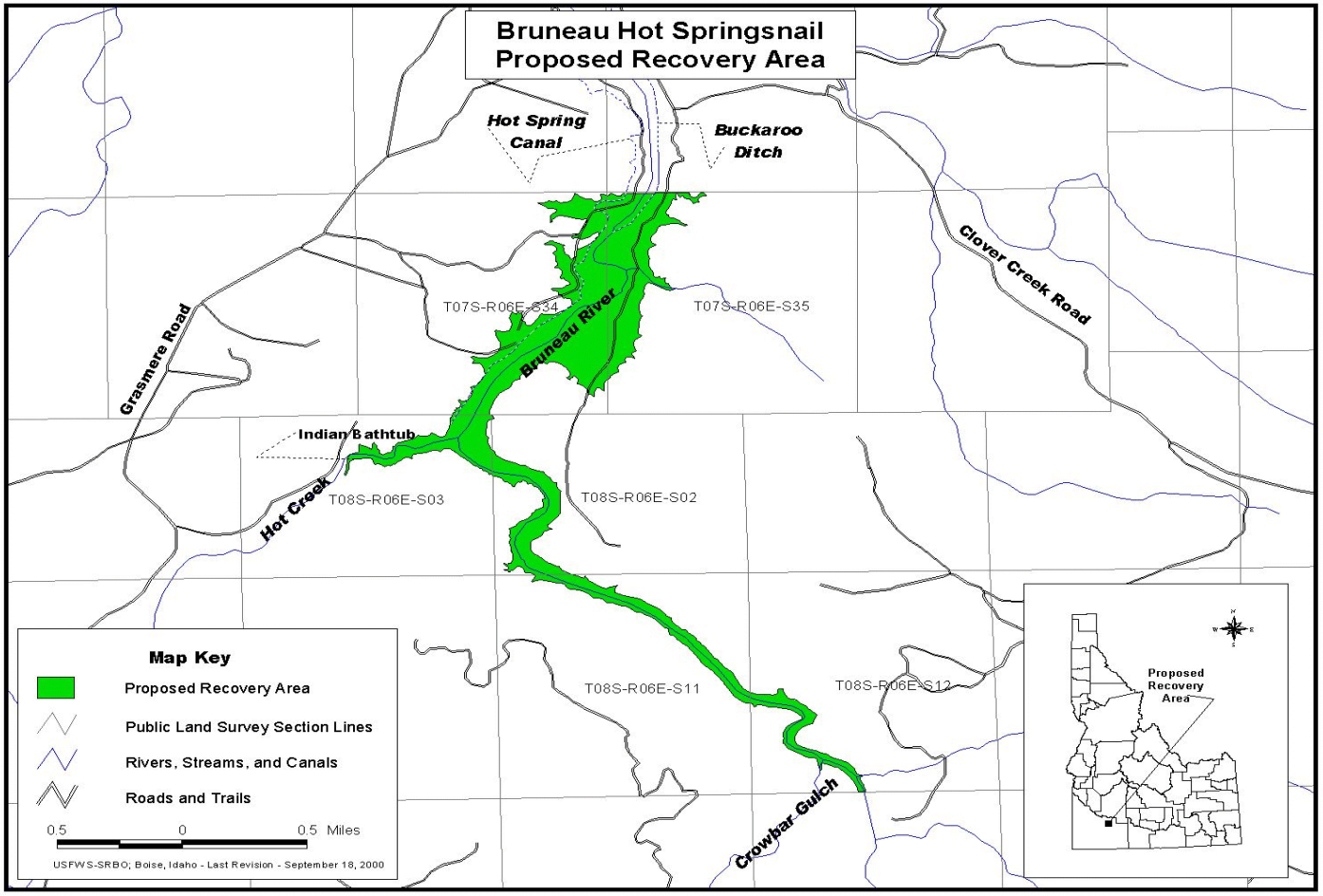

Figure 3. Map of the recovery area for Bruneau hot springsnail. The recovery area begins at the point where the Bruneau River (flowing from the south to the north) crosses the southern boundary of Township (T) 08 South (S), Range (R) 06 East (E), Section (S) 12 and continues downstream (including Hot Creek from the confluence of the Bruneau River to the Indian Bathtub) to the point where the Bruneau River crosses the northern boundary of T07S, R06E, S35 of Owyhee County, Idaho (all within East Boise Meridian).

gigantea (giant helleborine), a rare species of orchid, has been found in Hot Creek and along the Bruneau River associated with geothermal spring outflows. Other aquatic associates include two non-native fish species, *Poecilia reticulata* (a guppy) and a species of *Tilapia*. Guppies were apparently released into upper Hot Creek at the Indian Bathtub, from which they spread downstream and into nearby geothermal springs and seeps along the Bruneau River (Bowler and Olmstead 1991).

C. The Geothermal Aquifer

The geothermal spring habitats of the Bruneau hot springsnail are formed as a result of water discharging from faults or fractures originating from the underlying, confined volcanic-rock (geothermal) aquifer (Berenbrock 1993). These natural, geothermal springs (seeps or vents) discharge at the ground surface where the ground surface level or elevation is lower than the potentiometric or hydraulic head of the geothermal aquifer. As hydraulic pressures change (increase or decrease) within the geothermal aquifer as a result of recharge or continued groundwater pumping, the presence or absence of geothermal springs and the amount of surface area covered by springflows reflect these changes. The regional geothermal aquifer underlies a 1,554-square-kilometer (600-square-mile) area, which includes the Little, Sugar, and Bruneau Valleys in north central Owyhee County (designated the Bruneau/Grandview area) and is underlain with hydraulically connected sedimentary and volcanic rocks that together form the regional geothermal aquifer (Berenbrock 1993).

Groundwater in the regional geothermal aquifer originates through natural recharge from precipitation in and around the Jarbidge and Owyhee Mountains south of the Bruneau/Grandview area (Young and Lewis 1982, Mink 1984). Groundwater flows northward from volcanic rocks to sedimentary rocks where it is discharged as either natural springflow or groundwater well withdrawals, or leaves the area as underflow (Berenbrock 1993). Water in the volcanic rock in the northern part of the regional geothermal aquifer, near Hot Creek, is confined by the overlying sedimentary rocks, with temperatures at the surface ranging from 15 degrees Celsius (59 degrees Fahrenheit) to more than 80 degrees Celsius (176 degrees Fahrenheit) (Young *et al*. 1979). Natural recharge to the regional

geothermal aquifer is estimated to be approximately 57,000 acre-feet of water annually (Berenbrock 1993). Prior to extensive development, approximately 10,100 acre-feet of water was discharged from springflows alone. Underflow leaving the study area to the Bruneau and Snake Rivers was incalculable (Berenbrock 1993) but is assumed to equal, with springflow discharge, the natural recharge rate to the aquifer.

D. Reasons for Decline

There are more than 50 wells on private lands within 12.0 kilometers (7.5 miles) of the Indian Bathtub site utilizing geothermal waters for irrigation (Berenbrock 1993). Groundwater withdrawal and pumping threaten the Bruneau hot springsnail through a reduction or loss of geothermal spring habitats resulting from the depletion of the regional geothermal aquifer underlaying the Bruneau Valley area (Table 1). Within the past 30 years, discharge from many of the geothermal springs along Hot Creek and the Bruneau River has decreased greatly or ceased flowing, thus restricting springsnail habitat through the loss of wetted surface area (Young *et al*. 1979; Berenbrock 1993; Mladenka 1992, 1993; Mladenka and Minshall 1996; Myler and Minshall 1998) (Figures 4a - c). Changes in discharge at the geothermal springs correspond with changes in hydraulic pressure which fluctuate seasonally and are substantially less during late summer, when water withdrawals are greatest, than in the spring (Figure 5). From 1890 to 1978, well withdrawals increased from zero to approximately 49,900 acre-feet of water per year (Berenbrock 1993). Between 1978 and 1991, total well withdrawals averaged 42,000 acre-feet per year (Berenbrock 1993). Since 1992, the U.S. Geological Survey has continued monitoring of groundwater withdrawals and groundwater levels in a select number of springs and monitoring wells in the Bruneau/Grandview area. Withdrawals have averaged 53,800 acre-feet of water per year since 1992 and have been generally increasing since 1992 to a high of 66,200 acre-feet in 1999 (Table 1). Data for the 2001 monitoring year indicate a return to declining groundwater levels exceeding 1994 levels, previously the lowest monitored levels since 1991 (D. George, in litt. 2001).

Table 1. Ground water withdrawals (in acre-feet) for five water management units in the Bruneau-Grandview Groundwater Management Area (D. George, in litt. 2001).

Unit	1992	1993	1994	1995	1996	1997	1998	1999	2000
Bruneau Valley	5,800	5,700	5,200	4,900	5,500	5,700	6,800	7,800	7,500
Sugar Valley	6,400	5,700	6,700	6,400	7,100	5,900	5,700	6,500	8,200
Little Valley	31,800	29,800	32,400	27,200	28,500	31,100	32,000	34,400	30,900
Grand View	6,100	4,700	6,800	5,300	6,400	4,800	6,400	8,900	9,400
Castle Creek	9,100	7,000	8,200	6,200	6,000	6,500	6,900	8,600	9,900
Total	59,200	52,900	59,300	50,000	53,500	54,000	57,800	66,200	65,900

As of June 1997, there were 24 active Conservation Reserve Program agreements (acreage totaling 2,784 hectares; 6,880 acres) in the Bruneau area, 13 of which expired in October 1997, 8 in October 1998, and the remaining in October 1999. The Conservation Reserve Program is a conservation measure we support that temporarily removes private land from agricultural production thereby creating improved wildlife habitat and reducing groundwater withdrawals from the geothermal aquifer that would previously have irrigated the land enrolled in the program. There were approximately 6,400 hectares (15,822 acres) enrolled in the Conservation Reserve Program for all of Owyhee County. There has been no continuation of the Conservation Reserve Program in Owyhee County since 1999 due to a dramatic decline in monetary compensation per acre of land and, consequently, much of this land is now irrigated by geothermal waters. Bruneau hot springsnails have been eliminated from upper Hot Creek, including the type locality at the former Indian Bathtub spring site. Spring discharge at the Indian Bathtub declined from an estimated 9,300 liters per minute (2,400 gallons per

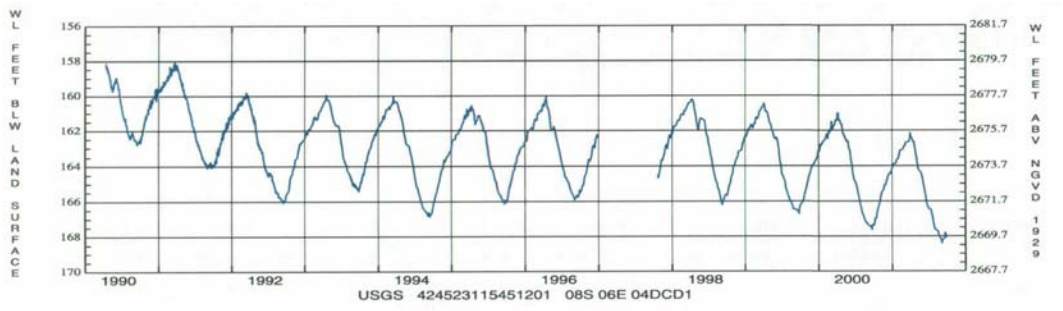

Figure 4a.

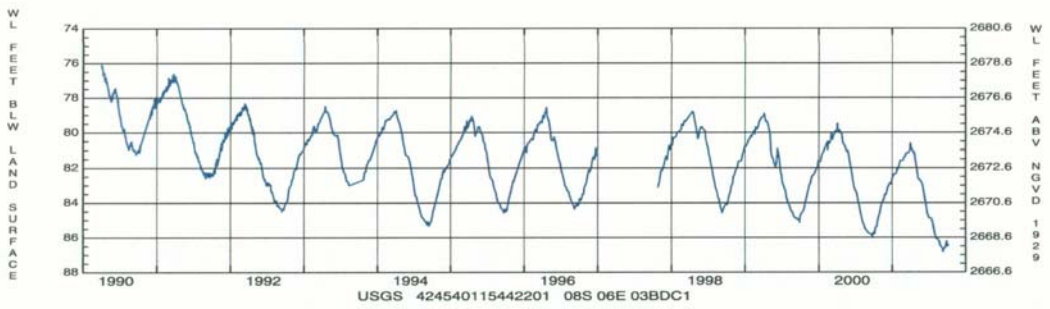

Figure 4b.

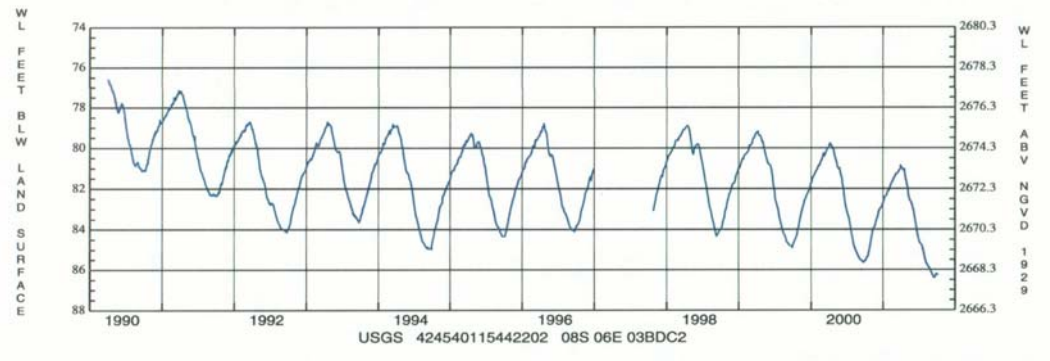

Figure 4c.

Figures 4a - c. Trends in three U. S. Geological Survey geothermal aquifer monitoring wells near the Indian Bathtub recreation area from 1990 to 2000 (D. George, in litt. 2001).

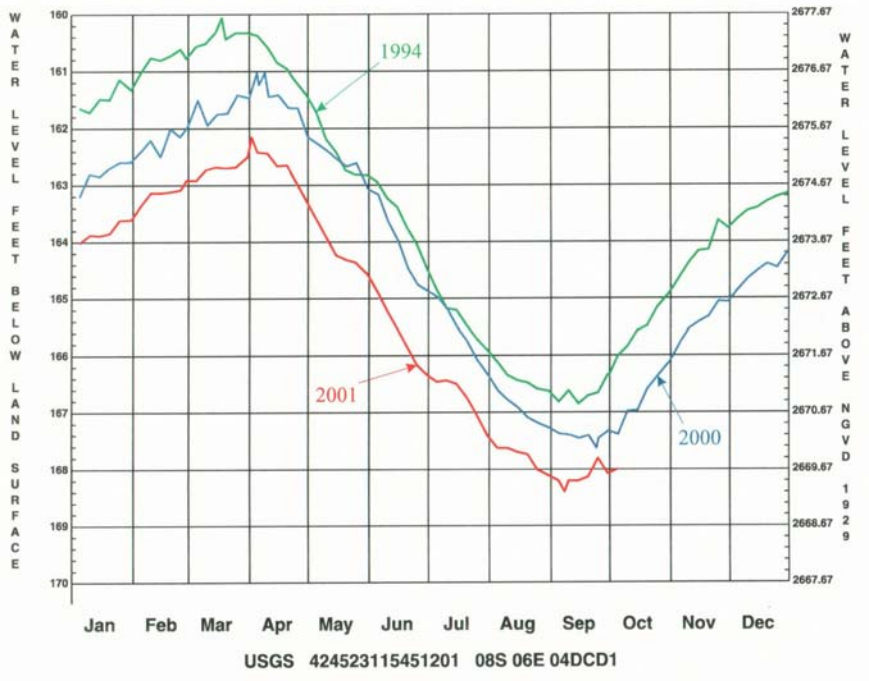

Figure 5. Annual fluctuations in one U. S. Geological Survey geothermal aquifer monitoring well near Indian bathtub recreation area (D. George, in litt. 2001).

minute) in 1964 to zero discharge by 1990 during the summer and early fall (Young *et al*. 1979, Berenbrock 1993). Visible spring discharge at the Indian Bathtub continues to be low and seasonally variable, ranging between 5.6 and 11 liters per second (0.21 and 0.39 cubic foot per second) with drying in the summer and early fall in most years (Varricchione and Minshall 1997; D. George, in litt. 2000). Today, water from the Indian Bathtub sinks below the ground surface and reemerges about 450 meters (984.3 feet) below the spring outlet area (Rugenski and Minshall 2002).

In 1991, a flash flood event in the Hot Creek drainage resulted in large amounts of sediment filling in the Indian Bathtub, causing a 50 percent reduction in the size of the Indian Bathtub (a portion of which is now covered by approximately 3 meters [10 feet] of sediment) (Mladenka 1992). The typical Bruneau hot springsnail rockface habitats of Indian Bathtub were severely reduced and

covered with sediment during this and other flash flood events (Mladenka 1992). Soils information from the Bureau of Land Management (S. Sather-Blair, in litt. 1993) suggests that the lower end of the Hot Creek drainage is highly erosive and probably was never stabilized with a heavy ground cover of perennial plants. Because visible spring discharge at the Indian Bathtub continues to be low and intermittent in most years (Varricchione and Minshall 1997; D. George, in litt. 2000), Bruneau hot springsnails have been unable to migrate to or inhabit the original upper Hot Creek/Indian Bathtub sites (Varricchione and Minshall 1997). Varricchione and Minshall (1997) suggested several factors including unsuitable substrate type (primarily silt and sand, with little to no available rockface surfaces), weak migration abilities, fish predation, and a lack of an upstream colonization, that may have prevented the Bruneau hot springsnails from returning to the upper Hot Creek and Indian Bathtub sites. While flash floods probably occurred historically, the effects of declining springflows on the flushing of sediment deposited, and filling in of springsnail habitats at the Indian Bathtub and upper Hot Creek, have likely resulted in the permanent loss of suitable habitat at the Indian Bathtub.

Bruneau hot springsnails are also vulnerable to a variety of introduced predators (Mladenka 1992). The presence of the wild populations of non-native guppies and a species of *Tilapia* in Hot Creek and many of the small geothermal springs along the Bruneau River is a threat to the Bruneau hot springsnail (Myler and Minshall 2000). The presence of these non-native fish may restrict repopulation of the Bruneau hot springsnails into Hot Creek (Varricchione and Minshall 1997, Myler and Minshall 2000) and at other geothermal spring sites. Both of these non-native fish species migrate into the Bruneau River corridor, both upstream and downstream of Hot Creek, to other spring outflows when temperatures in the Bruneau River are suitable (during the summer months). Movement of these non-native fish species into other geothermal springs occupied by the Bruneau hot springsnail will likely affect the springsnail within individual spring sites, and will likely affect the springsnail's ability to disperse to other available geothermal habitats downstream. As typical habitats, such as rockfaces with flowing water (Myler and Minshall 2000), continue to be reduced or eliminated, use of the less desirable remaining geothermal springs increases the vulnerability of the Bruneau hot springsnail to predation.

Currently, the mandates of most state resource agencies do not extend protection to invertebrate species. The Idaho Department of Water Resources can regulate water development in the Bruneau/Grandview area through a variety of administrative policies and State laws. However, under existing State laws, any conservation measures imposed by the Idaho Department of Water Resources to manage groundwater are only for the purpose of fulfilling senior water rights and not for the protection of fish and wildlife resources. The Idaho Department of Water Resources has the authority to control groundwater and can limit the development of new wells in a critical groundwater area, impose water conservation measures including the repair of leaking or uncontrolled flowing wells, and require meters on existing wells (Idaho Department of Water Resources 1992). At present, there is no specific allocation of either surface or groundwater in the Bruneau/Grandview area for the protection and conservation of fish and wildlife. The Idaho Department of Water Resources has designated the Bruneau/Grandview area a Groundwater Management Area, which allows the Idaho Department of Water Resources to hold applications for water permits until it can be demonstrated that the proposed withdrawal will not adversely impact other water rights in the Groundwater Management Area (Idaho Department of Water Resources 1992). Groundwater Management Area designations, however, are intended only to maintain sufficient groundwater to fulfill existing water rights and supply the needs of irrigation. Holding of new applications for water permits does not include new applications for domestic water use or the deepening of existing wells. An artesian well inventory conducted by the Idaho Department of Water Resources (1992) identified several surface leaking wells that might be wasting water in the subsurface due to inappropriate well construction techniques. In 1985, two water-wasting wells were repaired. However, other wells, especially those leaking at the subsurface level, have not been addressed (G. Spackman, in litt. 1993).

In summary, since 1991, the total number of springs, both occupied and unoccupied, hot springsnail densities, and groundwater levels measured at the Indian bathtub continue to decline (Tables 1 and 2). As geothermal aquifer levels

Table 2. Total number of springs, springs occupied by Bruneau hot springsnails, and water level measurements of two wells located near the Indian Bathtub spring (Myler and Minshall 1998; Mladenka and Minshall 1996; U.S. Geological Survey, in litt. 1999).

Year	Total Number of Springs	Number of Occupied Springs	October Elevation of Well #03BDC1	October Elevation of Well #03BDC2
1991	211	131	2,672.74 feet	2,672.56 feet
1993	201	128	2,672.24 feet	2,671.45 feet
1996	204	116	2,671.65 feet	2,671.39 feet
1998	155	89	2,671.57 feet	2,671.23 feet
2000	Data not available	Data not available	2,668.6 feet	2,668.9 feet

continue to decline, and the number of springs and occupied springs follow, populations of Bruneau hot springsnails are extirpated locally and face increasing risk of extinction (Figure 6).

Some groundwater conservation measures have been implemented and water savings have been achieved, but groundwater levels and associated springflows continue to decline. To recover the Bruneau hot springsnail, it is imperative that remaining springsnail habitats be preserved, and this will require a marked reduction in groundwater withdrawals from the geothermal aquifer. It is estimated that unless current rates of geothermal aquifer water withdrawal are not stabilized or reversed, Bruneau hot springsnails may become extinct by the year 2012 (Myler 2000; Figure 6).

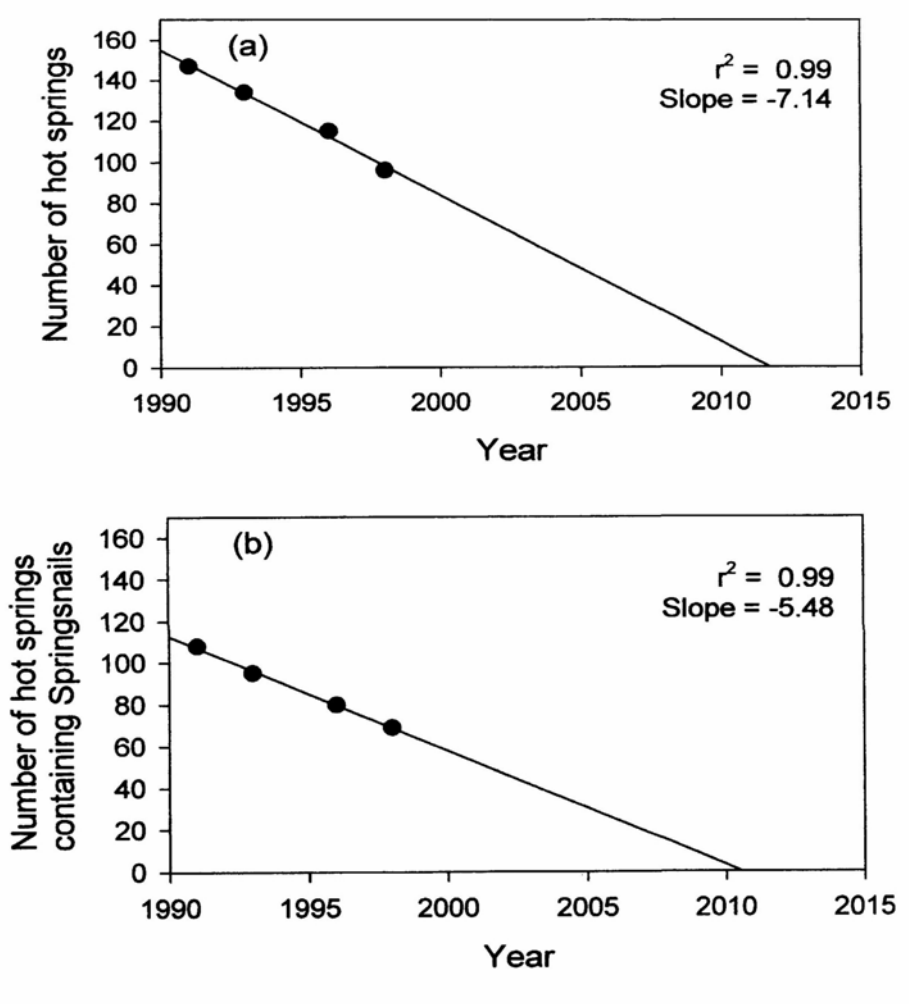

Figure 6. Simple linear regression to predict point in time when (a) number of hot springs and (b) number of hot springs containing springsnails reaches zero if the decline continues at the present rate (from Myler, 2000).

E. Conservation Measures

1. Congressional Appropriations

In 1987, approximately $800,000 was appropriated in our budget by the U.S. Congress to fund studies to be used in the development of a cooperative conservation plan to conserve and protect the Bruneau hot springsnail. Three agencies conducted these studies: the Idaho Department of Water Resources, the U.S. Geological Survey, and Idaho State University. The Idaho Department of Water Resources was funded to: 1) prepare a Geographic Information System map for the study area to provide a detailed information base from which to derive management decisions, including existing data and data to be developed by the U.S. Geological Survey and Idaho State University; 2) prepare geological maps to define the bedrock geology and record the location, elevation, flow, and temperature of area springflows; and 3) evaluate and analyze Federal and State laws applicable to a conservation plan for the Bruneau hot springsnail and assess management alternatives open to the Idaho Department of Water Resources to protect Bruneau hot springsnail habitats. The Idaho Department of Water Resources has not finalized the conservation plan. The U.S. Geological Survey was funded to develop and implement a three-phase groundwater study of the Bruneau River valley and basin. The study focused on describing the hydrology of the regional geothermal aquifer system and associated geothermal springs, with an overall goal to determine the cause of declining springflows affecting the Bruneau hot springsnail and its habitat. Finally, funds were provided to Idaho State University to study the biological, ecological, and physiological needs of the Bruneau hot springsnail.

In Fiscal Years 1999 and 2000, an additional $1 million was appropriated in our budget by Congress to aid the State of Idaho in implementing water conservation activities for the Bruneau hot springsnail. Recovery of the Bruneau hot springsnail is dependent on the State of Idaho Department of Water Resources, the Bruneau Hot Springsnail Conservation Planning Committee, and any State and Federal agency on the committee obtaining additional funding to implement groundwater conservation measures in the Bruneau-Grandview Water Management Area.

2. Programs under the Idaho Department of Water Resources

The Idaho Department of Water Resources, under the authority of State laws, regulates groundwater development in the Bruneau area. In 1982, the Idaho Department of Water Resources established the Bruneau-Grandview Groundwater Management Area, an administrative tool which allows the Idaho Department of Water Resources to continue to receive and retain without action applications for water permits until it can be demonstrated that sufficient water is available, and the withdrawal will not adversely impact other water rights within the Bruneau area (Idaho Department of Water Resources 1992). Due to declining groundwater levels in the area, no applications for withdrawal within the Groundwater Management Area, except those for domestic purposes, have been approved since 1982. The Idaho Department of Water Resources has a critical role in the conservation of the Bruneau hot springsnail as it legally manages the appropriation of water resources in the State. Some suggested conservation measures that should be considered by the State are the establishment of a "water bank" for water saved by conservation measures and protected by the State against future claims of appropriation, the transfer of abandoned or forfeited water rights to the aforementioned water bank, or the establishment of instream minimum flows in Hot Creek for the conservation of Bruneau hot springsnail habitat.

3. State of Idaho Bruneau Hot Springsnail Conservation Strategy

In 1998, the State of Idaho established a strategy planning committee, of which we are an active member. The main objective of the committee is to develop and implement a conservation strategy that will reduce the use of groundwater for irrigation. Possible activities being considered by the committee include the "rental" of groundwater rights by the State for a 15-year term and funding of water conservation projects and repair of leaking wells (at both the surface and subsurface levels). The State will use the expertise of the committee to prioritize and fund individual projects as proposals are submitted by agencies or individuals. Project priorities will be determined via the following guidelines: a) cost effectiveness/sharing; b) location or the proximity to the spring system in the Bruneau River; c)

duration; and d) total groundwater savings expected. All proposals will include some mechanism for monitoring and accounting for water savings. Previously, the strategy relied solely on Federal funds provided by Congressional appropriations for Fiscal Years 1999 and 2000. Additional funding for projects subsequent to issuance of this plan will be needed to implement this conservation strategy.

4. Programs under the Bureau of Land Management

The Bureau of Land Management manages Federal land containing Bruneau hot springsnails and their habitats along Hot Creek and the Bruneau River. The Bureau of Land Management issues permits for livestock grazing on these lands and grants authorizations for grazing and land exchange that could lead to the drilling of new wells or increased groundwater use on these lands. In 1992, the Bureau of Land Management installed fencing to protect Bruneau hot springsnail habitat from grazing impacts in the Hot Creek watershed, from above Indian Bathtub to the confluence of Hot Creek and the Bruneau River. Fencing has been installed along the canyon rim of the Bruneau River to further control livestock use of the river on Federal lands within the recovery area.

Since 1993, a Cooperative Challenge Cost Share Project with the Bureau of Land Management and Idaho State University has continued to monitor key habitat variables (Hot Creek discharge, temperature, and water chemistry), and springsnail abundance and population structure at the four study sites on a monthly basis (excluding February and December). This information has been essential for refining our understanding of springsnail population dynamics and monitoring spring outflows in Hot Creek. We were a cooperator in initiating an expanded monitoring program in Fiscal Year 2000 (see number 5 below).

5. Programs under the Fish and Wildlife Service

In late 1989, using funding provided through the Congressional appropriation described above, we contracted researchers from Idaho State University to

initiate a comprehensive ecological life history study of the Bruneau hot springsnail. The study described the life history of the springsnail, characterized the species physical habitat requirements, and examined its regional distribution in Hot Creek and nearby geothermal springs (Mladenka 1992).

In 1990, we provided funds, through the Congressional appropriation described above, to fence the Indian Bathtub, a privately-owned in-holding within the Hot Creek watershed. A conservation easement was signed between us and the landowner to continuously maintain the fencing. The current landowner continues to honor the original conservation easement.

In an effort to continue the 1991 rangewide surveys for all geothermal springs and geothermal springs occupied by Bruneau hot springsnails along the Bruneau River and Hot Creek, we have provided funding to Idaho State University every 2 to 3 years. Surveys were completed in 1993, 1996, and 1998. Results of these surveys indicate a 27 percent decline in the total number of springs since 1991; from 211 to 155. The number of geothermal springs occupied by Bruneau hot springsnails has also shown a nearly 32 percent decline since 1991; from 131 to 89.

We have provided funding every year since Fiscal Year 1993, (with the exception of 1997) to the U.S. Geological Survey to conduct groundwater, spring discharge, and annual withdrawals monitoring. Groundwater monitoring efforts have included measurements at 6 continuous groundwater level recorders, 10 monthly and 1 semiannual observation wells, 8 monthly spring discharge measurements, and computation of annual groundwater withdrawals. Beginning in 2001, the State of Idaho has agreed to fund monitoring of the 10 monthly and 1 semiannual observation wells and will continue groundwater monitoring in the future. We will continue to fund spring discharge measurements and population monitoring at 21 occupied geothermal spring sites as funding remains available (see description below).

As part of the change in monitoring responsibilities described above, we provided funding to Idaho State University in Fiscal Year 1999 for the

development of an expanded biological and habitat monitoring program within the range of the Bruneau hot springsnail. Expanded monitoring includes the 4 monitoring sites established in 1993, and an additional 17 occupied sites above and below the confluence of Hot Creek for a total number of 21 monitoring sites. The monitoring program measures spring discharge where discharge can be measured, density of springsnails present, water temperature and conductivity, and measures of flowing and wetted surface area dimensions. Photographs and site descriptions are made and each site has been labeled for ease of relocation. Monthly monitoring will commence in April or May, when water levels in the Bruneau River are low enough to allow access to all monitoring sites, and continue through October. We, in cooperation with the Bureau of Land Management and Idaho State University through the Bureau of Land Management's Challenge Cost-Share Program, have begun funding monitoring on a yearly basis.

6. Programs under the U.S. Department of Agriculture

The U. S. Department of Agriculture Natural Resources Conservation Service provides money and assistance to landowners who wish to participate in wildlife and wildland conservation through the Conservation Reserve Program, Wetlands Restoration Program, and Wildlife Habitat Incentives Program. One or more of these programs may be appropriate for landowners who wish to reduce impacts on Bruneau hot springsnails or their habitat.

The Conservation Reserve Program is a voluntary program under the Farm Service Agency, authorized under the Food Security Act of 1985, as amended, that offers rental payments, incentive payments for certain activities, and cost-share assistance to establish approved cover on eligible cropland. This program encourages farmers to plant long-term resource-conserving covers to improve soil, water, and wildlife resources. The duration of the contracts are between 10 and 15 years. As of 1999, all lands formerly enrolled in the Conservation Reserve Program in Owyhee County (approximately 2,784 hectares [6,880 acres]) were no longer participants in the program. It is unlikely that all those eligible for new Conservation Reserve Program agreements will participate due to a dramatic drop in the rental rates (from

about $20 per hectare [$50 per acre] to about $7 per hectare [$17 per acre]) currently being offered through the program. Area landowners have indicated that this drop in rental fees will not provide the necessary incentive to continue participating in the Conservation Reserve Program. The Farm Service Agency should, in cooperation with the State through the strategy, seek additional rental fees for willing participants in the program.

The Wetlands Reserve Program is a voluntary program to restore and protect wetlands on private property. The Natural Resource Conservation Service, in cooperation with the Farm Service Agency, manages the Wetlands Reserve Program. Landowners who participate can either sell a permanent conservation easement to the U. S. Department of Agriculture or enter into a cost-share agreement with the U. S. Department of Agriculture to protect and restore wetlands. The program is quite flexible and offers several options for enrollment, generally with a minimum enrollment period of 10 years in duration from the time of signing a Wetlands Reserve Program contract. Depending on the enrollment option, the U. S. Department of Agriculture will pay between 75 and 100 percent of the costs associated with the restoration activity. The Wetlands Reserve Program may or may not be applicable to the conservation of Bruneau hot springsnail habitat and may not apply to riparian areas adjacent to Hot Creek or the Bruneau River, however, it may represent a possible alternative to the Conservation Reserve Program if that program is no longer cost effective for landowner participation.

The Wildlife Habitat Incentives Program is another voluntary incentive program for people who want to improve or protect wildlife habitats on private lands. This program works by preparing cooperative wildlife conservation plans between landowners and Federal agencies that describes goals for improving wildlife habitat, a list of practices to be used in realizing those goals, and an implementation schedule for attaining those goals. Agreements generally last from 5 to 10 years with the U. S. Department of Agriculture providing technical assistance in developing plans and funding of up to 75 percent of the wildlife habitat implementation costs. As with all of the above programs, landowners, if they chose, maintain ownership of the lands participating in the program and may continue current land use practices

with relatively few restrictions. The Wildlife Habitat Incentives Program could conserve Bruneau hot springsnail habitat by drafting goals designed to reduce the amount of geothermal aquifer water used for irrigation. It is the geothermal aquifer water which ultimately creates snail habitat and, thus, warrants protection.

II. Recovery

A. Recovery Objectives and Strategy

The recovery area is defined as beginning at the point where the Bruneau River (flowing from south to north) crosses the southern boundary of Township (T) 08 South (S), Range (R) 06 East (E), Section (S) 12 and continuing downstream (including Hot Creek from the confluence of the Bruneau River to the Indian Bathtub) to the point where the Bruneau River crosses the northern boundary of T07S, R06E, S35 of Owyhee County, Idaho (all within East Boise Meridian) (Figure 3).

Recovery is contingent upon conserving the geothermal aquifer and increasing the number of geothermal spring habitats within the recovery area for Bruneau hot springsnails, while acknowledging that geothermal groundwater can continue to be managed to fulfill other beneficial uses. Strategies to achieve recovery include the following action items:

1. Implement conservation measures to increase water levels in the regional geothermal aquifer (Priority 1)[3]. Recovery will require that all available geothermal spring seeps and outflows discharging within the recovery area between an elevational range of 803.7 to 816.96 meters (2,636.9 to 2,678.54 feet) are secure. This can be accomplished by implementing conservation measures that increase water levels (or spring discharge) in the regional geothermal aquifer and prevent any further declines.

2. Implement a groundwater monitoring program to assess increases, or declines, in the geothermal aquifer (Priority 1). Continued groundwater monitoring is necessary to continue to assess the effects of groundwater withdrawals and conservation on water levels in the regional geothermal aquifer that supplies water to the geothermal springs occupied by Bruneau hot springsnails.

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[2] See Section V, Implementation Schedule, for a complete definition of priorities.

3. Monitor the survival and recovery of the Bruneau hot springsnail and its habitat (Priority 1). Concurrent with the groundwater monitoring program, continued monitoring of springsnail habitats and spring discharge is necessary to detect and evaluate trends in springsnail abundance and persistence. This information is also necessary to evaluate the effectiveness of conservation measures.

4. Develop and implement a habitat restoration program within the recovery area (Priority 2). Habitat restoration within the recovery area may allow the species to disperse to currently unoccupied geothermal spring habitat as it becomes available.

5. Develop and implement a control program for non-native fish that prey upon the Bruneau hot springsnail within the recovery area (Priority 2). Control of non-native fish that prey on Bruneau hot springsnails within the recovery area may allow the species to disperse to currently unoccupied geothermal spring habitat as non-native fish are eliminated.

6. Manage Federal lands to promote recovery of the Bruneau hot springsnail (Priority 3). The Bureau of Land Management has the responsibility to not permit any activities on Federal lands under the Bureau of Land Management's jurisdiction that would jeopardize the survival of endangered or threatened species or destroy or adversely modify their critical habitat. To that end, the Bureau of Land Management should continue to manage activities on Federal lands that may jeopardize the survival of the Bruneau hot springsnail (*e.g.* livestock grazing or off-road vehicle travel). The Bureau has installed fencing along the east and west side of the Bruneau River and the Hot Creek watershed to prevent the trampling of riparian vegetation by cattle and the subsequent erosion and siltation of Bruneau hot springsnail habitat. In addition to fencing activities, the Bureau of Land Management assesses land exchanges with private landowners that may otherwise convert rangeland to irrigated croplands that would use geothermal waters for irrigation.

7. Continue to support research on the conservation of the Bruneau Hot Springsnail (Priority 3). Develop a groundwater recharge model that will

assist in determining levels of pumping that do not result in continued decline of the geothermal aquifer. Conduct research to determine the feasibility of restoring Upper Hot Creek as suitable springsnail habitat, and translocation and establishment of additional springsnail colonies within the recovery area.

8. Seek funding for implementation of recovery tasks (Priority 1). Additional funding will be needed to continue implementation of several recovery tasks, including implementation of water conservation activities, continued groundwater monitoring, and Bruneau hot springsnail population and spring discharge monitoring.

9. Recovery Plan Assessment. The recovery plan should be updated as recovery tasks are accomplished, or revised as environmental conditions in the Bruneau/Grandview area change and as additional information becomes available.

B. Recovery Criteria

The Bruneau hot springsnail will be considered for reclassification from endangered to threatened when it is demonstrated that:

1. Groundwater and habitat management activities that provide for the protection of the Bruneau hot springsnail's geothermal habitats are implemented; and

2. Following implementation of the groundwater and habitat management activities, water levels in the geothermal aquifer (*i.e.,* spring discharge) have shown an increasing trend over a period of 10 years toward the recovery goal of at least 815 meters (2,674 feet) above sea level (as measured in October, annually, at U.S. Geological Survey well number 03BDC1, 03BDC2, and 04DCD1) and the number of geothermal springs have increased to approximately 165 seeps and are well distributed within the recovery area.

Bruneau hot springsnails will be considered for delisting when it is demonstrated that:

1. Water levels in the geothermal aquifer are being maintained at 815 meters (2,674 feet) above sea level (this value approximates the average elevation of 2,673.7 feet in October of 1990; D. George, in litt. 2001), as measured in October, annually, at the Hot Creek monitoring wells (U.S. Geological Survey well number 03BDC1, 03BDC2, and 04DCD1);

2. The geothermal springs number more than 200 in October, and are well distributed throughout the recovery area (this value approximates the 204 geothermal springs censussed in 1996; Mladenka and Minshall, 1996);

3. Greater than two-thirds of available geothermal springs (approximately 131 springs) are occupied by medium to high density populations of Bruneau hot springsnails (1,650 to 10,000 snails/ m^2) (Rugenski and Minshall 2002); and

4. Regulatory measures are adequate to permanently protect groundwater against further reductions.

III. Step-down Narrative Outline for Recovery Actions

Tasks described under number 1 below are the short-term recovery measures that are essential to prevent extinction of the Bruneau hot springsnail and halt further declines in its habitat.

1 <u>Implement conservation measures to increase water levels in the regional geothermal aquifer</u>.

To promote recovery of the Bruneau hot springsnail, water levels in the geothermal aquifer must be increased to an elevation of 815 meters (2,674 feet) within the recovery area. Water levels in the geothermal aquifer will be measured at monitoring wells located near Indian Bathtub (USGS well number 03BDC1, 03BDC2, and 04DCD1). To achieve recovery, protection of the geothermal aquifer supplying springsnail habitats (geothermal springs) must be accomplished. Several options exist to accomplish this task including, but not limited to, continued implementation of the State's Bruneau Hot Springsnail Conservation Strategy, development of a Water Management District, renewal of Conservation Reserve Program agreements, and maintenance of the Groundwater Management Area in perpetuity. The Idaho Department of Water Resources administers water rights and regulates water management in the Bruneau area. Therefore, by exercising their water management authority, the Idaho Department of Water Resources can lawfully assist efforts to conserve and increase geothermal aquifer levels essential to maintaining and increasing springsnail habitat.

1.1 <u>Continue implementation of the State of Idaho Bruneau Hot Springsnail Conservation Strategy to meet recovery objectives and criteria set forth in this recovery plan</u>.

The State of Idaho has a key role in implementing the strategy for the conservation of the Bruneau hot springsnail (see conservation measure number 2). The Idaho Department of Water Resources has the legal authority to control geothermal groundwater withdrawal rates to implement water conservation measures in the Bruneau-Grandview Water Management Area

for the purpose of recovering the Bruneau hot springsnail (see Reasons for Decline, p. 7). The strategy currently includes a monitoring component that will help determine the effectiveness of any conservation efforts applied through implementation of the strategy. The Strategy Planning Committee (Committee) should pursue additional funding and continue to review and approve proposals, based on criteria described in conservation measure number 3, and the Committee should pursue a course of action intended to permanently reduce the amount of groundwater used for irrigation. While Federal funding was provided for the first 2 years of implementation in 1999 and 2000, the Committee should address future alternative and additional funding sources to continue implementation of the strategy should Federal funding sources become unavailable. The State should use the expertise of the Committee, particularly from various agency biologists and hydrologists, to prioritize and fund individual projects as proposals are submitted by agencies or individuals. Project priorities will be determined according to the following guidelines: a) cost effectiveness/sharing; b) location or proximity to the spring system in the Bruneau River; c) duration; and most importantly d) total water savings expected. Funding should not be provided for projects proposing to shift water withdrawals from the geothermal aquifer to Hot Creek or the Bruneau River. Likewise, funding will be denied unless water savings from conservation measures will be permanently retired and protected by the State from subsequent claims to water appropriations. To be considered, all proposals should include some mechanism for monitoring and accounting for water savings for a period of at least 5 years. The strategy is being implemented using Federal funds provided by Congressional appropriation for Fiscal Years 1999 and 2000. Additional funding for projects should be sought for this project through grants, and State and Federal funds.

Activities associated with implementation of the strategy should also lead to achievement of the recovery objectives and criteria set forth in this document, including permanent protection of the geothermal aquifer with measured water levels at an elevation of 815 meters (2,674 feet) (as measured at U. S. Geological Survey monitoring wells number 03BDC1, 03BDC2, and 04DCD1). Implementation of recovery task 1.1 is necessary to ensure the continued survival and recovery of the Bruneau hot springsnail.

1.2 Implement minimum in-stream flows for Hot Creek for invertebrates and vertebrate fish and wildlife.

The Idaho Department of Water Resources has the authority to regulate water development in the Bruneau-Grandview Groundwater Management area. Currently, the Department of Water Resources does not implement conservation measures for the protection of invertebrates and vertebrate fish and wildlife. However, the Department of Water Resources has the authority to implement minimum in-stream flows and to hold applications for water permits until it has been demonstrated that the proposed withdrawal will not adversely affect other water rights within the Groundwater Management Area. Thus, by implementing minimum in-stream flows of 0.02 m^3 sec^{-1} in Hot Creek for invertebrates and vertebrate fish and wildlife, the Department of Water Resources can simultaneously hold water permits that would adversely affect those flows, meet Recovery Objective and Strategy 1, and meet the State of Idaho strategic planning committees' main goal of reducing the use of geothermal groundwater for irrigation. Implementation of recovery task 1.2 is also necessary to ensure the continued survival and recovery of the Bruneau hot springsnail.

1.3 Pursue the permanent acquisition of non-use groundwater rights.

The Bruneau hot springsnail Conservation Committee has entered into several short-term non-use agreements with groundwater rights holders to conserve geothermal aquifer water for the Bruneau hot springsnail. However, the geothermal aquifer water being saved is not protected from subsequent use by other water rights holders. The Fish and Wildlife Service, Bureau of Land Management, Idaho Department of Water Resources, and the Committee should pursue the permanent acquisition of non-use groundwater rights from current groundwater rights holders and protect them in perpetuity.

1.4 Maintain and evaluate the Groundwater Management Area.

As described in conservation measure number 1, the Idaho Department of Water Resources established the Bruneau-Grandview Groundwater

Management Area. Water levels in the geothermal aquifer have not stabilized, however, and have continued to decline. Efforts are currently underway by the Idaho Department of Water Resources to permanently establish a moratorium on all new irrigation and other large-volume consumptive uses. This moratorium, however, does not restrict the development of new geothermal wells for domestic uses, or the lowering of pumps in existing wells. The use and deepening of existing geothermal wells for domestic, human consumption, and municipal purposes should be allowed to continue. However, the construction of new wells and deepening of existing wells for irrigation or other large-volume consumptive uses should be disallowed unless it can be demonstrated that the withdrawal will not adversely affect the Bruneau hot springsnail or any federally protected aquatic species within the Bruneau-Grandview Groundwater Management Area.

1.5 Develop and implement a Water Management District for the Bruneau-Grandview area.

In 1995, the State authorized the development and supervision of Water Management Districts by the Idaho Department of Water Resources for the purpose of measuring and reporting water diversions. Activities to be performed include monitoring of geothermal groundwater levels at groundwater diversions before and during pumping activities; and immediate reporting to the Director of the Idaho Department of Water Resources any water diversions that may have been diverted without a water right or in violation of an existing water right. To date, the Bruneau-Grandview Water Management Area has not been designated as a Water Management District.

Once a Water Management District has been developed for the Bruneau-Grandview Water Management Area, implementation of monitoring and reporting activities should begin. Implementation of this task can include incorporation of groundwater monitoring tasks described under task number 2 below.

1.6 Repair leaking artesian wells.

In May 1993, the Idaho Department of Water Resources identified 13 wells leaking artesian water from the geothermal and cold-water aquifers underlaying the Bruneau area. Repairing these leaks will help conserve groundwater and maintain pressures in the geothermal aquifer.

1.7 Expand groundwater monitoring in the Bruneau, Sugar, and Little Valleys to include the effects of granting additional water rights.

Groundwater monitoring should include a review of any additional requests for new water rights (including agricultural and domestic water rights) and their potential effects on decreasing water levels in the geothermal aquifer.

1.8 Implement Programs under the authority of the United States Department of Agriculture Natural Resource Conservation Service (USDA - NRCS).

The U. S. Department of Agriculture Natural Resources Conservation Service has many programs designed to assist private landowners who wish to set aside lands for the purpose of fish and wildlife conservation and critical habitat protection. These programs can assist in the conservation of the Bruneau hot springsnail by promoting conservation measures to reduce the use of geothermal aquifer waters, protecting critical aquatic habitats, and creating conservation easements for future wildlife protection.

1.9 Improve the efficiency of existing groundwater irrigation systems to conserve the use of geothermal water.

Idaho Department of Water Resources can, through its authority to regulate groundwater development, require measurement and reporting of existing withdrawals, limit or prohibit new appropriations, or curtail or reduce diversions in order of priority to bring withdrawals into balance with the reasonably anticipated average rate of future natural recharge (Idaho code §§ 42-233a, 42-233b, and 42-237a). Compliance with any State regulations should use current best management practices to maximize the efficiency of

irrigation systems. The above mentioned best management practices, regulations, and limitations would be further detailed by Idaho Department of Water Resources in their finalized conservation plan and should not conflict with other details of this plan.

2 Groundwater monitoring.

As part of the statewide groundwater monitoring program, continued groundwater monitoring will be necessary to assess the fluctuations in levels of water in the geothermal aquifer and the effects of any efforts to conserve and increase geothermal water levels. Groundwater withdrawals (*i.e.*, pumping) can vary seasonally due to the availability of precipitation and surface water runoff, and can be regulated through management of local or regional pumping (Idaho Department of Water Resources 1992, Berenbrock 1993). The Idaho Department of Water Resources monitoring program should include: a) measuring water levels in the geothermal aquifer at several wells distributed throughout the Bruneau area, and b) computing annual groundwater pumping from an appropriate number of wells distributed throughout the area, to compare changes in water use and water availability with trends in groundwater levels and geothermal spring discharges (Berenbrock 1993).

2.1 Continue monitoring of the geothermal aquifer.

Continue to conduct groundwater monitoring as is necessary to assess the effects of water conservation actions on groundwater levels and springsnail habitats. The State currently monitors groundwater levels in the Bruneau-Grandview area and is authorized to regulate water management through development of a Water Management District (Task 1.3).

3 Monitor the survival and recovery of the Bruneau hot springsnail.

Population monitoring of the Bruneau hot springsnail has occurred since 1991. Continued monitoring will provide the additional information necessary to evaluate the status of the species, future management activities, and any recovery/conservation measures.

3.1 Continue expanded springsnail monitoring program.

The ongoing investigation by Idaho State University to monitor key habitat variables in Hot Creek and sites in the Bruneau River below the confluence of Hot Creek was expanded to include 17 additional monitoring sites along the Bruneau River canyon upstream and downstream of Hot Creek (see conservation measure number 5). Parameters that will be measured include spring discharge where discharge can be measured, estimated density of springsnails present, water temperature and conductivity, and measures of flowing and wetted surface area dimensions. All monitoring sites will be located via the Global Positioning System. We, in cooperation with the Bureau of Land Management, shall continue implementation of the expanded monitoring plan, dependent on available funding.

3.2 Continue surveys of all geothermal springs in the recovery area on a biannual or triennial basis.

Surveys to determine the total number of geothermal springs and the current distribution and population status of Bruneau hot springsnails in the recovery area have been conducted every 2 to 3 years (see conservation measure number 5). Survey parameters include Global Positioning System locations of all spring sites (occupied and unoccupied), estimation of Bruneau hot springsnail densities at occupied sites, temperature and conductivity. Continuation of the biannual surveys will provide information on whether the number of geothermal springs are increasing and whether the Bruneau hot springsnail has the ability to colonize new geothermal spring sites.

4 Develop and implement a habitat restoration program within the recovery area.

Habitat restoration in the recovery area may allow the species to disperse to currently unoccupied geothermal spring habitats as it becomes available.

4.1 Develop a habitat restoration plan to facilitate the re-colonization of lower Hot Creek by Bruneau hot springsnails.

One option for the restoration of springsnail habitat includes providing corridors for springsnail passage into lower Hot Creek, constructing fish exclosures (outlined in section 5.2), and providing large diameter substrates in Hot Creek for movement, feeding, escape from lethal temperatures, and egg laying.

4.2 Implement the habitat restoration plan to facilitate the re-colonization of Hot Creek by Bruneau hot springsnails.

Upon completion of recovery task 4.1, implement the habitat restoration measures outlined in the plan.

5 Develop and implement a non-native fish control program within the recovery area.

5.1 Evaluate the feasibility of controlling non-native fish in the recovery area.

To develop a control program for non-native fish, it will be necessary to determine what mechanisms are available that will not harm Bruneau hot springsnails and will function as an effective fish control mechanism. Also, it will be necessary to determine which parts of the recovery area are suitable for fish control mechanisms.

5.2 Develop a non-native fish control program that is not detrimental to the Bruneau hot springsnail.

Depending on the outcome of task 5.1, a control program for non-native fish should be developed, while protecting Bruneau hot springsnails. One possible, non-intrusive method is the construction of fish exclosures that prevent the passage of fish into Hot Creek but allow the passage of the very small springsnail. Alternative non-native fish control methodologies will have

to be determined for the Bruneau River as it is too large to install and maintain permanent barriers to fish passage.

5.3 Implement a non-native fish control program.

Upon completion of task 5.2, a non-native fish control program should be implemented in the Bruneau River and Hot Creek in areas considered suitable for such control mechanisms (see 5.1).

6 Manage Federal lands to promote recovery of the Bruneau hot springsnail.

The Bureau of Land Management has installed fencing along the east and west side of the Bruneau River and the Hot Creek watershed. In addition to fencing activities, the Bureau of Land Management assesses land exchanges with private landowners that may otherwise convert rangeland to irrigated croplands using geothermal waters.

6.1 Continue to monitor and assess impacts of cattle operations on Bureau of Land Management lands.

The Bureau of Land Management should conduct periodic site surveys to inspect the fencing, repair any damage to the fences, and document the recovery of the riparian corridor along the Bruneau River and Hot Creek.

6.2 Assess and regulate any Federal land exchanges within the Little, Sugar, or Bruneau Valleys.

Any Federal land exchanges, mainly on Bureau of Land Management land, should be assessed for the potential future use of the land once out of Federal ownership. Land exchanges should not occur if future uses would result in development of the geothermal aquifer.

7 **Continue to support research on the conservation of the Bruneau hot springsnail**.

Additional research should include development of a groundwater recharge model that will assist in determining levels of pumping that do not result in continued decline of the geothermal aquifer; the feasibility of restoring Upper Hot Creek as suitable springsnail habitat; and translocation and establishment of additional springsnail colonies within the recovery area.

7.1 Develop and implement a model to determine the amount of water withdrawal that can occur while maintaining geothermal spring discharge at the 815 meters (2,674 feet) elevation level.

The State of Idaho Department of Water Resources has been charged with developing a model of groundwater withdrawals using data from the current groundwater monitoring program. Information from this model could be used to determine the amount of withdrawals that can occur based on current precipitation levels and crop types, while maintaining water levels in the geothermal aquifer that allow geothermal spring discharge to occur at 815 meters (2,674 feet) of elevation.

7.1.1 Develop water withdrawal model.

A water withdrawal model should be developed to determine the amount of water that can be withdrawn from the geothermal aquifer each year, without reducing water levels below 815 meters (2,674 feet).

7.1.2 Utilize water withdrawal model.

Once task 7.1.1 has been completed, the water withdrawal model should be implemented as a tool for management of water levels in the geothermal aquifer.

7.2 Evaluate the feasibility of restoring Indian Bathtub and Hot Creek below Indian Bathtub as suitable springsnail habitat.

The effects of declining springflows coupled with periodic flash flooding and recent drought conditions have resulted in the permanent elimination of springflows and filling in of springsnail habitats at Indian Bathtub, the species type locality. Efforts could include the removal of non-native vegetation, including trees, along Hot Creek below Indian Bathtub to allow for an increase in the surface flows from the Indian Bathtub spring. Sediment removal at Indian Bathtub may also provide additional rockface habitat at the level of geothermal spring discharge.

7.3 Determine the feasibility of translocation and establishment of additional springsnail colonies along the Bruneau River.

Once water levels in the geothermal aquifer are assured, there may be unoccupied geothermal springs that may provide suitable springsnail habitat within the recovery area. Efforts could be made to determine if Bruneau hot springsnails can be translocated to these unoccupied sites.

7.3.1 Evaluate potential translocation sites.

A survey of all potential geothermal springs that are not currently occupied by Bruneau hot springsnails should be conducted within the recovery area between 787 to 816 meters (2,580 to 2,675 feet) above sea level to evaluate their suitability for translocation. Emphasis should be placed on springs which occur on public lands, although privately owned spring sites with interested and willing landowners should also be evaluated. This task will involve describing various water habitat attributes for each potential spring site, including water temperature, depth, substrate, food availability, flow, and elevation.

7.3.2 Develop a Bruneau hot springsnail translocation plan.

A translocation plan should be developed, based on springsnail life history requirements and availability of suitable translocation sites. The plan should identify viable springsnail colonies from which specimens can be obtained for translocation and should specify monitoring protocols necessary to determine the success of any transplantation efforts.

7.3.3 Implement a springsnail translocation program.

Using recommendations developed in task 7.3.2, introduce the Bruneau hot springsnail into suitable geothermal spring sites within the recovery area.

7.3.4 Monitor translocated colonies.

To determine the success of translocation, newly colonized spring sites should be monitored annually according to monitoring protocols developed in task 7.3.2.

8 Secure funding for implementation of recovery tasks.

Long term additional funding will be needed to implement the recovery tasks, including continued groundwater monitoring, Bruneau hot springsnail population monitoring, spring discharge monitoring, development of a geothermal water withdrawal model, and implementation of water conservation activities approved by the Strategic Planning Committee through implementation of the State's Bruneau Hot Springsnail Conservation Strategy.

The State of Idaho should take the lead to secure Federal funding to assure continued Bruneau hot springsnail population and spring discharge monitoring activities. The State could take the lead to secure funding, through Federal, State, or other funding sources, to assure completion of several recovery tasks, including continued groundwater monitoring, development of a geothermal water

withdrawal model, and implementation of water conservation activities through the State's Bruneau Hot Springsnail Conservation Strategy.

9 Recovery plan assessment.

The response of the Bruneau hot springsnail to conservation measures associated with recovery efforts will be determined by developing a long-term species and habitat monitoring program. Although much of this monitoring can be accomplished by on-going State and Federal programs, additional actions and monitoring may be necessary.

9.1 Biannually assess the overall success of the recovery program and revise the recovery plan on a 5-year basis, if necessary.

The recovery plan should be updated as recovery tasks are accomplished, or revised as environmental conditions in the recovery area change, and as additional information becomes available. The recovery plan assessment can be achieved formally through biannual agency review/meetings where annual monitoring reports and summaries are submitted and evaluated, or informally through distribution of annual monitoring reports and summaries submitted to us by the various agencies.

IV. Implementation Schedule

The Implementation Schedule that follows outlines actions and estimated costs for this recovery plan. It is a guide for meeting the objectives discussed in this recovery plan. This schedule describes and prioritizes tasks, provides an estimated timetable for performance of tasks, indicates responsible agencies, and estimates costs of performing tasks. These actions, when accomplished, should recover the Bruneau hot springsnail (*Pyrgulopsis bruneauensis)*.

Priorities in column 1 of the following implementation schedule are assigned as follows:

Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Priority 2 - An action that must be taken to prevent a significant decline in species' population/habitat quality, or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to provide for full recovery of the species.

Responsible parties: An asterisk (*) in the implementation schedule indicates the lead responsible party.

BLM- Bureau of Land Management, Boise Field Office
BHSSCC- Bruneau Hot Springsnail Conservation Committee
FWS- U.S. Fish and Wildlife Service, Snake River Basin Office, Boise, Idaho
IDA- Idaho Department of Agriculture
IDWR- Idaho Department of Water Resources
ISU- Idaho State University
NRCS-Natural Resources Conservation Service
PVT- Private landowners
SCD- Soil Conservation District, Owyhee County
State- State of Idaho

Implementation schedule for the recovery plan for the Bruneau hot springsnail *(Pyrgulopsis bruneauensis)*										
Task Priority	**Task Number**	**Task Description**	**Task Duration (years)**	**Responsible Parties**	**Cost Estimate (in $1,000 units)**					**Comments**
					Costs 03-13[4]	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	
1	1.1	Continue implementation of the State of Idaho Bruneau Hot Springsnail Conservation Strategy to meet recovery objectives and criteria set forth in this recovery plan	20	State	5,000	500	500	500	500	Implementation will be dependent on continuation of funds secured (see task 8); previous funds have been provided through Congressional Appropriation in Fiscal Years 1999 and 2000
1	1.2	Obtain and hold senior water rights for invertebrates and vertebrate fish and wildlife	20	IDWR, State	0	0	0	0	0	Costs associated with recovery action 1.2 are part of the administration costs of IDWR and BHSSCC
1	1.3	Pursue the permanent acquisition of non-use groundwater rights	20	FWS, IDWR, BHSSCC	500	50	50	50	50	Costs associated with recovery action 1.3 can be estimated by IDWR and BHSSCC; remaining costs incurred subsequent to FY 2006
1	1.4	Maintain and evaluate the Groundwater Management Area	20	IDWR	0	0	0	0	0	Costs associated with recovery action 1.4 are part of the administration costs of IDWR

Implementation schedule for the recovery plan for the Bruneau hot springsnail *(Pyrgulopsis bruneauensis)*										
Task Priority	**Task Number**	**Task Description**	**Task Duration (years)**	**Responsible Parties**	**Cost Estimate (in $1,000 units)**					**Comments**
					Costs 03-13[4]	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	
1	1.5	Develop and implement a Water Management District (WMD)	1	IDWR	0	0	0	0	0	Costs associated with recovery action 1.5 are part of the administration costs of IDWR
1	1.6	Repair leaking artesian wells	10	IDWR, BHSSCC	0	0	0	0	0	Repair dependant upon identification of leaking wells and funding from BHSSCC
1	1.7	Expand groundwater monitoring in the Bruneau, Sugar, and Little Valleys to include the effects of granting additional water rights	20	IDWR	500	50	50	50	50	
1	1.8	Implement programs under the USDA NRCS	20	USDA - NRCS, State	0	0	0	0	0	On-going administrative costs incurred by NRCS
1	1.9	Improve the efficiency of existing groundwater irrigation systems to conserve the use of geothermal water	20	BHSSCC	0	0	0	0	0	Costs for recovery action 1.9 will be dependent on project proposals submitted to the Bruneau Hot Springsnail Conservation Committee for funding approval

Implementation schedule for the recovery plan for the Bruneau hot springsnail *(Pyrgulopsis bruneauensis)*										
Task Priority	**Task Number**	**Task Description**	**Task Duration (years)**	**Responsible Parties**	**Cost Estimate (in $1,000 units)**					**Comments**
					Costs 03-13[4]	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	
2	2.1	Continue monitoring of the geothermal aquifer	20	IDWR	730	70[4]	72	74	76	Remaining costs incurred subsequent to FY 2006
2	3.1	Continue expanded springsnail monitoring program	20	FWS*, BLM	207.5	20	20.6	21	21.6	Funding will be appropriated to ISU which completes the monitoring program; remaining costs incurred subsequent to FY 2006
2	3.2	Continue surveys of all geothermal springs in the recovery area on a biannual or triennial basis	20	FWS	26	5	0	5.3	0	Funding will be appropriated to ISU which completes the geothermal spring surveys; remaining costs incurred subsequent to FY 2006
2	4.1	Develop a habitat restoration plan to facilitate the re-colonization of lower Hot Creek by Bruneau hot springsnails	2	FWS, ISU, BHSSCC	50	0	0	0	25	Costs incurred will be part of FWS and BHSSCC administrative expenses, funding will be appropriated to ISU for research and development of the restoration plan; remaining costs incurred subsequent to FY 2006

[4] Costs associated with tasks 2.1, 3.1, 3.2, 8.1 include 3 percent inflation increases from one year to the next.

Implementation schedule for the recovery plan for the Bruneau hot springsnail *(Pyrgulopsis bruneauensis)*									
Task Priority	**Task Number**	**Task Description**	**Task Duration (years)**	**Responsible Parties**	**Cost Estimate (in $1,000 units)**				**Comments**
					Costs 03-13[4]	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	
2	4.2	Implement the habitat restoration plan to facilitate the re-colonization of lower Hot Creek by Bruneau hot springsnails	10	FWS, ISU, BHSSCC	100	0	0	0	0	All costs associated with this task will occur subsequent to FY 2006
2	5.1	Evaluate the feasibility of controlling non-native fish in the recover area	1	IDFG	0	0	0	0	0	Costs associated with recovery action 5.1 are part of the administration costs of IDFG
2	5.2	Develop a non-native fish control program that is not detrimental to the Bruneau hot springsnail	3	IDFG	30	0	10	10	10	Costs for Tasks 5.2 and 5.3 dependent upon design of non-native fish control program utilized. Subsequent costs may be needed to maintain efficacy of fish control program
2	5.3	Implement a non-native fish control program	20	IDFG	60	0	0	0	0	Will be considered complete once it is established that non-native fish are no longer breeding or surviving within the recovery area. All costs associated with this task will occur subsequent to FY 2006
2	6.1	Continue to monitor and assess impacts of cattle operations on BLM lands	20	BLM	0	0	0	0	0	Costs associated with recovery action 6.1 are part of the administration costs of BLM

Implementation schedule for the recovery plan for the Bruneau hot springsnail *(Pyrgulopsis bruneauensis)*										
Task Priority	**Task Number**	**Task Description**	**Task Duration (years)**	**Responsible Parties**	**Cost Estimate (in $1,000 units)**					**Comments**
					Costs 03-13[4]	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	
2	6.2	Assess and regulate any Federal land exchanges within the Little, Sugar, or Bruneau Valleys	20	BLM	0	0	0	0	0	Ongoing administrative expenses within the Bureau of Land Management
2	7.1.1	Develop water withdrawal model	1	IDWR	100	0	100	0	0	
2	7.1.2	Utilize water withdrawal model	15	IDWR	0	0	0	0	0	Upon completion of Task 6.1.1, costs part of IDWR administrative expenses
2	9.1	Biannually assess the overall success of the recovery program and revise recovery plan on a 5-year basis, if necessary	20	FWS	55	0	10	0	10.6	Remaining costs incurred subsequent to FY 2006
3	7.2	Evaluate the feasibility of restoring Indian Bathtub and the Hot Creek watershed below as suitable springsnail habitat	1	BLM*, FWS, PVT	10	0	0	0	0	All costs incurred subsequent to FY 2006, following completion of tasks 4.1 through 5.3
3	7.3.1	Evaluate potential translocation sites	1	FWS*, BLM	10	0	0	0	10	This task cannot be accomplished until higher priority tasks have been completed and water levels in the aquifer have been assured

Implementation schedule for the recovery plan for the Bruneau hot springsnail *(Pyrgulopsis bruneauensis*)

Task Priority	Task Number	Task Description	Task Duration (years)	Responsible Parties	Cost Estimate (in $1,000 units)					Comments
					Costs 03-13[4]	FY 2003	FY 2004	FY 2005	FY 2006	
3	7.3.2	Develop a Bruneau hot springsnail translocation plan	1	FWS*, BLM	10	0	0	0	10	This task cannot be accomplished until higher priority tasks have been completed and water levels in the aquifer have been assured
3	7.3.3	Implement a springsnail translocation program	5	FWS*, BLM	100	0	0	0	0	This task cannot be accomplished until higher priority tasks have been completed and water levels in the aquifer have been assured. All costs incurred subsequent to FY 2006
3	7.3.4	Monitor translocated colonies	10	FWS*, BLM	50	0	0	0	0	This task cannot be accomplished until higher priority tasks have been completed and water levels in the aquifer have been assured. All costs incurred subsequent to FY 2006
1	8	Secure funding for implementation of recovery tasks	20	FWS*, State, IDWR, BHSSCC	0	0	0	0	0	Costs associated with recovery action 8.0 are part of the administration costs of the various agencies
Total estimated cost for the first 10 years of recovery:					approximately $7.5 million					

[4] The estimated total cost of recovery is approximately $15 million, and is subject to change. Total costs in this column represent an estimate of the costs for the first 10 years and cannot guarantee that recovery objectives have been met.

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VI. Appendix A

Summary of agency and public comments on the draft recovery plan for the Bruneau hot springsnail

On January 9, 2001, we released the Draft Recovery Plan for the Bruneau hot springsnail for a 60 day public comment period that ended March 12, 2001, for Federal agencies, State and local governments, and members of the public. A total of eight letters were received, each with a varying number of comments.

The number of letters received by affiliation:

Federal agencies	2
State agencies	1
Academia/ professionals	1
Environmental/ conservation groups	3
Local governments	0
General public	1

Summary of significant comments and our responses:

The Service reviewed all of the comments received during the public comment period. Comments were generally constructive containing suggestions on how to improve the plan and provide greater protection for the Bruneau hot springsnail. All comments were considered and many are addressed in, or incorporated into, the body of this final Recovery Plan. The major comments communicated by more than one party and the our response to each are summarized as follows:

Comment: Increase geothermal aquifer monitoring efforts.
Response: We have increased the number of geothermal aquifer monitoring wells in the Recovery Plan from just one well, to three wells located near the Indian bathtub recreation area (see section IV - 1 in the Plan).

Comment: Specify densities of springsnail colonies to be used in recovery criteria.
Response: We have changed the Recovery Plan to explicitly define medium and high densities of Bruneau hot springsnails for the purpose of clarifying recovery criteria to be met (see section II - B in the Plan).

Comment: More springsnail habitat and population monitoring should be included in the plan.
Response: We have put in place an expanded biological monitoring program utilizing the existing relationship with the Department of Biological Sciences at Idaho State University (see section I - F 4 in the Plan).

Comment: Include more information on Federal aid for voluntary programs designed to conserve resources and protect wildlife habitat (*e.g.* Bruneau hot springsnail habitat).
Response: We have included more information in the Final Recovery Plan on government programs for private landowners who wish to conserve resources and protect wildlife habitat (see section IV - 1.6 in the Plan).

Comment: Lowering of existing wells and expansion of geothermal aquifer for domestic use should be disallowed.
Response: We have suggested that existing wells for domestic use be allowed to be deepened but that new wells and deepening of existing wells for irrigation or other large scale consumptive uses be prohibited (see section IV - 1.2 in the Plan).

Comment: Irrigation and leaking wells may contribute to aquifer changes, but it is difficult to quantify how much.
Response: We have detailed information on the rates of geothermal aquifer water withdrawals for irrigation and the associated level of the hydraulic head in the geothermal aquifer (see section I - D in the Plan) from 1990 to the present.

VII. Appendix B. Summary of Threats and Recommended Recovery Actions for the Bruneau hot springsnail.

LISTING FACTOR	THREAT	RECOVERY CRITERIA	TASK NUMBERS
A	Agricultural-related groundwater withdrawal and pumping which causes a reduction or loss of geothermal spring habitats	1, 2, 4	Implement conservation measures to increase water levels in the regional geothermal aquifer, continue monitoring of the geothermal aquifer, manage Federal lands to promote recovery, continue to support research on conservation, and secure funding (see Tasks 1.1 - 1.9, 2.1, 6.2, 7.1, 8)
C	Introduction of predatory exotic fish species (guppies and Tilapia) in Hot Creek and the Bruneau River drainage	3	Monitor survival and recovery, develop and implement a habitat restoration program, develop and implement a non-native fish control program, continue to support research on conservation, and secure funding (see Tasks 3.1, 3.2, 4.1, 4.2, 5.1, 5.2, 5.3, 7.3.1 - 7.3.4, 8)
D	The mandates of most state resource agencies do not extend protection to invertebrate species and there is no specific allocation of either surface or groundwater in the Bruneau/Grandview are for the protection and conservation of fish and wildlife	1, 2, 4	Implement conservation measures to increase water levels in the regional geothermal aquifer, continue monitoring of the geothermal aquifer, manage Federal lands to promote recovery, continue to support research on conservation, and secure funding (see Tasks 1.1 - 1.9, 2.1, 6.2, 7.1, 8)
E	Naturally occurring events (sedimentation and flash flood events)	1, 3, 4	Continue to support research on conservation (see Task 7.2)

Listing Factors:
A. The Present or Threatened Destruction, Modification, or Curtailment Of Its Habitat or Range
B. Overutilization for Commercial, Recreational, Scientific, Educational Purposes (not a factor)
C. Disease or Predation (no known diseases)
D. The Inadequacy of Existing Regulatory Mechanisms
E. Other Natural or Manmade Factors Affecting Its Continued Existence

Recovery Criteria

1. Water levels in the geothermal aquifer have increased and stabilized at 815 (2,674 feet) in elevation (as measured in October, annually, in three of the Hot Creek water monitoring wells for a period of 10 years.

2. The total number of geothermal springs discharging within the recovery area is 200 or more and are distributed within the current range of the Bruneau hot springsnail.

3. More than two-thirds of available geothermal springs within the recovery area (approximately 131 springs) are occupied by stable, medium to high density populations of the Bruneau hot springsnail.

4. Groundwater levels are permanently protected against further reductions through implementation of groundwater management activities.